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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/572,611	03/17/2006	John Petruzzello	PHUS030335	7660

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EXAMINER	
EFTEKHARZADEH, ARDESHIR	

ART UNIT	PAPER NUMBER
2809	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/572,611	PETRUZZELLO ET AL.	
	Examiner	Art Unit	
	Ardeshir Eftekharzadeh	2809	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _03/17/2006_ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-15_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) _9-15_ is/are allowed.

6)☒ Claim(s) _1,5 and 6_ is/are rejected.

7)☒ Claim(s) _2-4,7 and 8_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _17 March 2006_ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _March 7,2006_.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 1,5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kalkhoran et al, United States Patent 5,671,914 in view of Simpson et al. United States Patent 5,965,873.

Regarding **claim 1**, in column 12, lines 18-22 Kalkhoran et al teaches that according to Fig. 12A a “buried” insulator layer 212’ is formed that divides the substrate 206’ to an upper section 208’ and lower section 210’. The insulating layer 212’ is taught in Kalkhoran et al column 12, line 25 to be a SiO_2 layer and the substrate is taught in Figs. 11,12A-12D to be a Si substrate. In Fig. 11 and 12D and column 12,lines 31-35 Kalkhoran et al teaches the photodiodes 196’, 198’, 200’ formed on the SOI structure and evidently having different thicknesses. In Abstract lines 8-11, Kalkhoran et al teaches that the thickness at least in part determines the wavelength of photons detected by each of the detection elements. It has been taught in Kalkhoran et al column 12 lines 16-18, that the elements referred to with primed reference numeral are counterparts of elements taught in Fig. 11 without prime and in column 11, lines 23-25 it has been taught that the photodetectors 196-204 are wavelength selective with varying wavelengtrh cutoff and in column 11 lines 22-25, it has been taught that the wavelength

selectivity can be realized by varying the thickness 213. Since Kalkhoran et al is teaching that each photodetector with a different thickness has a different wavelength cutoff, Kalkhoran is implicitly teaching that thickness is determining which what portion of light is absorbed in the photodiode. Then it can be seen that since the rest of the light will go through, teachings contained in Kalkhoran et al imply that the thickness of the photodetectors determined the portion of light that goes through. That the photodetectors taught in Kalkhoran et al are photodiodes, can be seen from Fig. 12D and the fact that components in Fig 11 are counterparts to components in Fig. 12D and components in Fig. 11 are taught in the following from column 11, lines 14-18, where Kalkhoran teaches that each of the detectors 196-204 include photodiodes formed on a substrate 206. It is necessary for photodetectors to produce a signal. Such signal would necessarily be determined by the amount of light absorbed in the photodiode pn junction area. Since the portion that is not absorbed will go through, it can be seen that the portion that goes through, among other factors, determines the portion that is absorbed which in turn determines the signal. Kalkhoran et al teaches signal processor 254 in column 14, lines 13. Processor 254 must necessarily determine the portion of incident light passing in certain wavelength by "determining a proportion of incident light passing through each SOI photodiode" which it can do because the strength of signal depends on that proportion of incident light.

Although Kalkhoran et al teaches how signals are obtained it does not teach how the intensities of each color component are calculated. Particularly Kalkhoran et al is silent on the specifics of processor 254. Simpson et al however discloses a signal

processing unit. Simpson et al teaches the details of signal processing as follows. In column 4, lines 39-44, In equation 4, Simpson et al teaches a formula that gives the intensity of each component of light, as a function of wavelength (more precisely, it gives the intensity of light with wavelengths in a given interval). Equation (4) in Simpson et al, depends on a numeral matrix denoted by $\beta_{\lambda j}$ with λ being an integer index identifying the interval of wavelengths for which the number is given and j a number identifying a particular detector. Simpson et al, in column 6, equations (7) , (8) and (9), teaches how to compute the matrix $\beta_{\lambda j}$ from the signals that each detector produces. Therefore Simpson et al is providing for a method for "calculating color component intensities of the incident light based on the determined proportions". Using the signals generated by photodiodes taught in Kalkhoran et al, has the predictable result of generating the output which identifies the wavelength or color components of the incident light as taught in Simpson et al column 4, lines 38-40, by way of calculation detailed in page 5 and 4 discussed above. It would have been obvious to one of ordinary skill in the art at the time of invention to substitute the step of signal processing taught in Kalkhoran et al to have been performed via signal processor 254, by calculation process taught in Simpson et al (page 4,5 and equation 4,5,6,7,8 and 9) for the purpose of obtaining the predictable result of spectral component intensities as OUTPUT1 through n.

Regarding **claim 5**, the limitation that "a proportion of incident light passing through each SOI photodiode to the silicon substrate with respect to wavelength and the

thickness of the silicon layer" is given by $e^{-a_\lambda x}$ necessarily follows from the teachings of Kalkhoran et al for the following reasons.

When electromagnetic radiation is passing through a medium (for example photodiodes 196,198,200,202 or 204 in Fig. 11 taught in Kalkhoran et al.) after going through a distance of dx a fraction of its energy per unit time per unit area (denoted henceforth by I will be absorbed in the medium. Let dI be energy per unit of time per unit area perpendicular to the direction of radiation at $x+dx$ minus the same quantity evaluated at x where x is distance from the surface of diode where the radiation has entered the medium and a is the fraction of energy absorbed per unit distance traveled by the radiation per unit time. Then it follows that

$$dI = -aIdx \quad (1)$$

where I is the energy passing through at distance x from the surface of diode where the radiation has entered the medium and a is the fraction of energy absorbed per unit of distance traveled. Examiner takes Official Notice that a depends on wavelength as evidenced by the known fact that some media are transparent to certain wavelengths while opaque to the others. Therefore a can be denoted as a_λ to denote the wavelength dependence. It then follows that

$$\frac{dI}{I} = -a_\lambda dx \quad (2)$$

By integrating both sides of the equation it and setting the amount of energy entering the medium (e.g. photodiode, silicon, etc) at the surface to I_0 we have:

$$I = I_0 e^{-a_\lambda x} \quad (3)$$

The amount of radiation passing through a slab made from a certain medium is equal to amount of radiation that entered the medium minus the amount absorbed. The amount absorbed is given in equation (3) therefore the amount passing through is also given by the same equation. Therefore the limitation cited in **claim 5** necessarily follows from teachings of Kalkhoran et al by the laws of physics.

Regarding **claim 6**, it is evident from Fig. 12D taught in Kalkhoran et al that the photodiodes are vertical since the n doped area is at the top and the p doped area is at the bottom.

Allowable Subject Matter

Claims 2-4 and 7-8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 9-15 are allowed over the prior art of record.

Regarding **claim 9**, Kalkhoran et al teaches a silicon layer 208' that has been taught to be doped with p-type dopants at the bottom and n-type dopants at the top as taught by Fig. 12D thereby forming a "pn-junction". Kalkhoran et al also teaches an insulator layer 212' made from SiO_2 and therefore teaches a buried oxide layer. However layer 212' is under the layer 208' whereas **claim 9** is reciting that "a buried

oxide layer" is "formed on the silicon substrate". Therefore layer 208' can not be interpreted to be read on by "silicon substrate" recited in **claim 9.** The Si substrate 210' taught in Kalkhoran et al Fig, 12D is formed in a way that layer 212' is above it but is not taught to be doped and therefore "Si substrate" does not read on it. No trench or field oxide layer is taught to be formed in Kalkhoran et al in any of the embodiments taught therein.

Tsui et al. US Patent 5,945,722 teaches a color active sensor cell. Tsui et al in Fig. 3 teaches a p-type doped substrate with n+ doped regions forming vertical pn-junction photodiodes. Tsui et al discloses oxide layers 110,112,114 and 116 and FOX, field oxide layers. It has been taught in column 3, lines 28-31 that the oxide layers provide color filtering. Tsui et al however does not teach any buried oxide layer. Buried oxide layers are known in the art to be utilized for insulation and for preventing parasitic capacitance. Since photodiodes 10-1, 10-2, 10-3 and 10-4 are taught in Fig. 3 to be separated by FOX regions, (field oxide) and since light immediately enters the photodiode after going through the layers of oxide, it is not known to the examiner that there is a motivation for combining teachings of Kalkhoran et al with Tsui et al to modify Tsui et al by adding a buried oxide layer. Since it appears to the examiner that this would not improve the performance of the device taught in Tsui et al.

Regarding **claim 13**, Kalkhoran et al teaches a silicon substrate 210' and the silicon layer 208' in Fig. 12D. Kalkhoran et al also teaches an insulator layer 212' made from SiO_2 and therefore teaches a "buried oxide layer". However no field oxide layer

has been taught in Kalkhoran et al. Tsui et al US Patent 5,945,722 teaches a Field oxide layer in Fig. 3 and the oxide layers 110,112,114 and 116. It has been taught in Tsui et al. in column 2, lines 28-34, that the first layer of material has a thickness which is approximately equal to a first predetermined electromagnetic wavelength divided by a value equal to two times n where is an integer, the thickness of the first layer of material prevents light, which is defined by the first predetermined electromagnetic wavelength from penetrating into the first region. And in subsequent lines of 35-42 the analogous teachings are provided for second, third and fourth layers. Therefore Tsui et al teaches a method whereby adjusting the thickness of the oxide layer determines the light passing through. However since this method eliminates a certain wavelength by way of destructive interference, the proportion of light passing through is not proportional to the thickness of the oxide. Furthermore as it was discussed there is no motivation to combine the teachings of Kalkhoran et al with ones of Tsui et al to add a layer of buried oxide layer.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ardeshir Eftekharzadeh whose telephone number is (571) 270-3262. The examiner can normally be reached on M-Th 7:30 am to 6:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian T. Pendleton can be reached on (571) 272-7527. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

A.E.

BRIAN TYRONE PENDLETON
SUPERVISORY PATENT EXAMINER